PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A New or Improved Flexible Material, particularly suitable for use as a Protective Covering Material for Packaging and Preservation Purposes

We, E.P.S. (RESEARCH & DEVELOPMENT) LIMITED, a British Company of Staplehurst Road Sittingbourne, Kent, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a new or improvel flexible material, particularly suitable for use as a protective covering material for packaging and preservation purposes.

Valuable items, such as, for example, machine tools, aircraft components, engines of all kinds, and electrical and electronic apparatus, which have frequently to be transported over great distances or stored for long periods, are often subject to corrosion or other deterioration during transport or storage. Such deterioration is caused mainly by the action of moisture or moisture vapour on the items in question and under very damp climatic conditions the extent of deterioration may be considerable.

It is therefore desirable that such items should be enclosed in a covering which is proof against moisture and moisture vapour and several protective covering materials have been used or proposed for this purpose. Unfortunately, none of these materials has proved to be entirely satisfactory.

It is an object of this invention to provide an improved protective covering material.

According to this invention there is provided a flexible, protectitve, covering, sheet material comprising a layer of lead foil having adhered to each side thereof a sheet of a fabric impregnated with a flexible, thermoplastic synthetic resin and having a thickness of not less than 0.01 inch.

We have found that a flexible, protective, covering, sheet material according to this invention may be repeatedly folded or crumpled without cracking or puncturing of the foil so that its effectiveness as a moisture- and moisture vapour-transmission resistant barrier layer remains unimpaired.

The thermoplastic synthetic resins for forming the material according to this invention may be, for instance, polyethylene and polypropylene resins, but the preferred resins are vinyl chloride polymer and copolymer resins.

According to a further aspect of this invention, there is provided a method of forming a flexible, protective, covering, sheet material, such method comprising forming two sheets of a fabric impregnated with a flexible, thermoplastic synthetic resin and adhering the same to lead foil, one of said sheets to each side of the latter, by applying a suitable adhesive between the said sheets and lead foil and pressing the same together.

Although the said adhesive may be applied either to the lead foil or to the sheets alone, preferably the adhesive is applied to both the lead foil and the sheets.

According to a further feature of this invention, the adhesive used to secure the said sheets to the lead foil may conveniently be an adhesive, preferably a fire-resistant synthetic adhesive, having a good preliminary tack.

Advantageously the said adhesive is a solution of the combination of phenol-formaldehyde resin and a synthetic rubber compound. A suitable synthetic rubber compound is that solid under the Registered Trade Mark "Hycar".

The said fabric may be a natural fabric such as cotton, silk or any other fabric such

as rayon or a fabric made from synthetic fibres such as that sold under the Registered Trade Mark Terylene.

Owing to the slightly uneven surface possessed by the fabric, when the said sheets and lead foil are pressed together, the lead foil is slightly embossed or corrugated and is thereby rendered more flexible.

Preferably the material according to this invention is formed by first forming the said impregnated sheets and then adhering such sheets to the lead foil. If desired, however, the material may alternatively be formed by coating, e.g. using a spreading process, one side of a sheet of the selected fabric with a paste adapted to form, on the application of heat and pressure, the said thermoplastic synthetic resin, by then applying the adhesive to the fabric side of the coated fabric sheet and to one side of the lead foil, by hot calendering the assembly of coated fabric sheet and lead foil when impregnation of the fabric by the synthetic resin takes place and finally repeating the process to apply a second sheet of impregnated fabric to the other side of the lead foil. Advantageously each said hot calendering operation is followed by a cold calendering operation.

The paste used desirably comprises polyvinyl chloride and/or a vinyl chloride copolymer mixed with a plasticiser and heat and light stabilisers.

Conveniently the paste also includes pigments, for example to render the thermoplastic synthetic resin opaque to ultra-violet rays and, also conveniently, the paste is treated so as to be non-inflammable and resistant to the spread of flames.

This invention also includes a protective covering e.g. a bag or other container, tailored from material according to this invention.

Since the sheets adhered to the lead foil are formed of a heat-sealable material, a piece or part of a piece of flexible, protective, covering, sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may readily be tailored to suit the particular shape of such item and completely to enclose the latter.

Although two pieces of material according to this invention or two parts of a single piece of such material may be joined by overlapping the said pieces or parts and heat-sealing the same together, with a reinforcement if desired, preferably, one or more jointing members formed of a thermoplastic synthetic resin material heat-sealable with that used to form the reinforced sheets is or are inserted at the junction of the two pieces or parts to be joined and the latter are heat-sealed to the said jointing member or members.

Thus, according to a further aspect of this invention, there is provided a method of forming a flexible, protective, covering, container, such method comprising cutting from material according to this invention a plurality of pieces which, when fitted together, form a container of the desired shape, engaging each pair of adjacent edges of said pieces in a groove in an extruded jointing member comprising an extruded strip of an extrudable thermoplastic synthetic resin heat-sealable with the material according to this invention and joining the said pieces to said strip by the application of heat and pressure.

The said two pieces of material to be joined may be located in separate grooves in the jointing member or, alternatively, in a single groove in the latter. In the latter case, the two pieces of material are heat-sealed together as well as being heat-sealed to the jointing member.

Extremely efficient heat-sealing of pieces of material according to this invention may be achieved by using radio-frequency dielectric heating since the lead foil of the two pieces to be joined may be earthed by capacitive coupling and the output from a radio-frequency generator supplied to two electrodes which are electrically connected together and are applied to the jointing member, one adjacent to each of the said pieces. Alternatively, the potentials of the electrodes may form a balanced system about earth potentials.

It is often desired that some items which have to be protected for long periods against corrosion or other deterioration should be able to be inspected at intervals throughout such period. Often, with protective covering materials used hitherto, such an inspection has required that the protective covering be destroyed so that it has subsequently to be renewed.

It is a further object of this invention to provide a protective covering which can easily be opened and resealed. Thus according to a still further aspect of this invention, there is provided a flexible, protective, covering container formed of a flexible material comprising a moisture- and moisture vapour-transmission resistant barrier layer of lead foil having adhered to both sides thereof a sheet of a fabric impregnated with a flexible, thermoplastic, synthetic resin and having a thickness of not less than 0.01 inch and including a moisture vapour-tight, water-tight, air-tight and light-tight slide fastener affording access to the interior of the container.

In order that this invention may more readily be understood, reference will now be made, by way of example, to the accompanying drawings, in which:—

Figure 1 is a perspective view showing the joining together of two coplanar pieces of material according to this invention by means of an extruded jointing member;

Figure 2 is a cross-section of the jointing member of Figure 1;

Figures 3 and 4 are perspective views showing how jointing members of the form illustrated in Figures 1 and 2 may be mitred and used to form joints between several pieces of material according to this invention;

Figure 5 is a perspective view of a manually propelled sealing tool for use in joining two pieces of material using the jointing member of Figures 1 and 2;

Figure 6 is a fragmentary cross-section through the tool of Figure 5;

Figure 7 is a perspective view of a second form of manually propelled sealing tool;

Figures 8 and 9 are respectively an end-elevational view and a side-elevational view of an installation using the tool of Figure 7;

Figure 10 is a cross-section through a second form of jointing member for use in joining together pieces of material according to this invention;

Figure 11 is a perspective view showing how the corner of a container may be formed when the pieces of material forming such a container are joined using jointing members as shown in Figure 10;

Figure 12 is a cross-section through a base jointing member;

Figure 13 is a perspective view showing the use of the base jointing member of Figure 12;

Figures 14 and 15 are cross-sections of two forms of jointing member which may be used selectively as planar-, corner- and base-jointing members;

Figures 16, 17 and 18 show the three uses of the jointing members of Figures 14 and 15;

Figure 19 is a cross-section of a further jointing member for use in joining together two pieces of material according to this invention;

Figure 20 is a perspective view of a sealing machine having straight electrodes for use in joining two pieces of material together using the jointing member of Figure 19;

Figure 21 is a fragmentary cross-section through the electrodes of the machine of Figure 20;

Figure 22 is a fragmentary perspective view of a sealing machine similar to that shown in Figure 21, but having curved electrodes;

Figure 23 is a cross-section through one form of slide fastener suitable for use in a container made from material according to this invention;

Figure 24 is a perspective view of a slider for use in opening and closing the fastener of Figure 23;

Figure 25 is a cross-section of a second form of slide fastener suitable for use in a container made from material according to this invention;

Figure 26 is a plan view of the metal insert included in each part of the slide fastener of Figure 25;

Figure 27 is a cross-section of a third form of slide fastener suitable for use in a container made from material according to this invention, and

Figures 28 and 29 are plan views of the metal inserts included in the two parts of the slide fastener of Figure 27.

In the drawings, the flexible, protective, covering, sheet material according to this invention illustrated in various figures and indicated by the reference 1 will, by way of example, be assumed to comprise a layer of lead foil 2 having a thickness of about 0.003" to each side of which is adhered, by a synthetic adhesive formed of a solution of a combination of phenol-formaldehyde resin and the synthetic rubber compound known in the trade as "Hycar" (Registered Trade Mark), a layer 3 of woven cotton fabrics impregnated with a polyvinyl chloride resin and having a thickness of about 0.014" or 0.015".

The method used to form this material may advantageously be as follows:—

Firstly a woven sheet of cotton fabric is combined with a sheet of calendered polyvinyl chloride resin. Adhesive is then applied to the fabric side of the combined cotton fabric and polyvinyl chloride sheet and to one side of the lead foil. The adhesive coated faces of the two materials are then brought together and the assembly so formed hot-calendered. Subsequently the process is repeated to apply a second sheet of cotton impregnated with polyvinyl chloride to the other side of the lead foil.

The hot calendering is carried out at a minimum temperature of 250° F. and the calender rolls, the rolls feeding the foil and sheets and the rolls taking up the assembly formed are synchronised to a single speed so that no relative stretching occurs of the layers forming the assembly.

Instead of applying the two sheets to the lead foil one after the other, as above described, both sheets may, if desired, be applied at the same time.

The composition of the polyvinyl chloride composition used in the manufacture of the hereinbefore described material may be varied to suit the particular purpose to which the material is to be put. Thus, where the cold-flow and cold-flexibility characteristics of the material are required to be good, a sebacate type of plasticiser may be used, and, where the material has to be exposed for long periods to tropical sunlight, the pigments used may be such as to render the material resistant to ultra violet rays and may thus be selected mainly from the dark colour range, carbon black being a good pigment for this purpose.

Since the said sheets adhered to the lead foil are impregnated with polyvinyl chloride, a piece or part of a piece of the above described

flexible protective covering sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may be tailored to suit the particular shape of such item and completely to enclose the latter.

Although two pieces of material according to this invention or two parts of a single piece of such material may be joined by overlapping the said pieces or parts and heat sealing the same together, with a reinforcement if desired, preferably, one or more jointing members formed of a thermoplastic synthetic resin heat-sealable with the polyvinyl chloride resin used to form the impregnated cotton sheets in this embodiment of the invention is or are inserted at the junction of the two pieces or parts to be joined and the latter are heat-sealed to the said jointing member or members.

Figures 1 and 2 illustrate a suitable jointing member 4 which comprises an extruded strip of polyvinyl chloride resin having therein two longitudinal grooves 5 each adapted to receive a different one of the two pieces or parts to be joined.

In this case the pieces or parts of material to be joined are intended to be co-planar, or substantially co-planar, and the strip has a somewhat squat I-shaped cross-sectional form. It will be appreciated, however, that, where the pieces or parts of material are to be joined so that their planes are at an angle to one another, the said jointing member could comprise a strip having two longitudinal parts or flanges diverging from one another at the desired angle and having longitudinal grooves in their outer edges. A particularly useful jointing member would be one having an L-shaped cross-section (i.e. as shown in Figure 10) and having a longitudinal groove in the free edge of each flange of the member. Such a member would enable two pieces or parts of material to be secured together with their planes at right angles to one another.

Where, in the construction of a protective covering from material according to this invention, two or more of the jointing members 4 meet, they may, as shown in Figures 3 and 4, easily be mitred and heat-sealed together to produce a secure and sealed joint.

Although sealing of two pieces or parts of material according to this invention together or to a jointing member may be carried out by any method of applying heat, e.g. by induction heating or by hot-air heating, advantageously high-frequency dielectric heating is used.

Where high-frequency dielectric heating is used for sealing two pieces or parts of material together, the said two pieces or parts may be overlapped where the seal is to be made and moved, relatively to a live electrode located between the overlapping parts of the material, in a direction extending from the forward end of the electrode to the rear end thereof, pressure being applied to the overlapped parts of the material in a region immediately rearwardly of the rear end of the said electrode.

Advantageously, the electrode in this case may be of flat shoe form. However, the electrode could, if desired, vary in shape, depending on the type of seal required, i.e. a broad knife blade electrode could be used to produce a seal right up to the edge of the sheets, and to a depth depending on the distance that the knife blade is inserted between the sheets.

At the very high frequency used for dielectric heating the capacity effect of the large surface area of the lead foil laminate compared with the small area of the live electrode causes the lead foil to behave as a virtual earth and the high-frequency heating field is generated between the live electrode and each lead laminate, i.e. only where the polyvinyl chloride is required to be softened for the welding. Once the polyvinyl chloride has been sufficiently softened where desired, it only remains to unite the two layers under pressure. This is conveniently achieved by using suitably shaped follow-up pressure bars or a series of paired follow-up pressure rollers.

Where an extruded jointing member such as is shown in Figures 1 and 2 is used to form a joint between two pieces or parts of material, the said member is preferably laid on a suitably shaped supporting surface and a high-frequency sealing tool guided along the member so as to press the same towards said supporting surface.

Such a tool is illustrated in Figures 5 and 6. Referring to these figures, it will be seen that the tool comprises a radio-frequency dielectric heating head 6 having two parallel electrode limbs 7 spaced apart by a distance such that one limb registers with each of the grooves 5 in a member 4 when the tool is placed in position on such member. The tool may comprise two pairs of side-by-side electrode limbs each of the said pairs of limbs registering with one of the grooves 5.

The tool is also provided with a handle 8 whereby an operator may manually traverse the tool along and apply pressure to the jointing member and with a guard 9 for the head 6. Advantageously this guard, as shown, engages the edges of the extruded member 4 and acts to guide the tool along the latter. The guard 9 is conveniently transparent and may be advantageously formed of polymethyl methacrylate resin. Further, the guard 9 may, if desired, be spring-loaded so that the tool can run over a joint between two jointing members 4 without having to be lifted off from the member on one side of said joint and replaced on the member on the other side of said joint.

The tool may include in the heater circuit

a microswitch normally biased in a direction opening the said circuit, but positioned to close said circuit only when the electrode limbs of the tool are in contact with a jointing member.

Figure 7 illustrates a second form of tool which may be used in the jointing of two pieces of material using jointing members of the form shown in Figures 1 and 2. This tool, like that of Figure 5 includes a handle 8 and guard 9, but is of elongated form. In use, the tool is placed at the position to be welded, held under pressure while the radio-frequency field is applied and pressure maintained for the required time to consolidate the weld after switching off the field. The tool is then moved on and replaced on the work to overlap by a small amount the weld just made. The tool may be held in the hand or advantageously fitted to a hand press applying a known controlled pressure.

The radio-frequency generator 10 for the heater electrodes of either of the tools illustrated may conveniently be suspended, as shown in Figures 8 and 9, from an overhead track or rail 11 along which the generator may be traversed as necessary.

As in the already mentioned case of the sealing of two pieces or parts of material according to this invention together in overlapping relation, when a tool as above described is used for sealing such material to a jointing member 4, the lead foil 2 acts as a virtual earth and the high-frequency field is generated between the live electrodes and the foil of each piece or part of material. Since the live electrodes are always applied to an outer surface, they can be completely shrouded, e.g. by using the guard 9.

If desired, prior to sealing the material to a jointing member, such material may be connected thereto or "tacked" in a selected few places by spot welding.

The corners of a protective covering may also be formed by jointing members mitred and heat-sealed together. For example, in forming rectangular parallelipipedonal box-like covering from six panels of material, each panel forming a side of said covering and being secured to adjacent panels along edges of the covering, the jointing members may conveniently be of an L-shaped cross-section as shown at 12 in Figure 10 and the three mutually perpendicular jointing members meeting at each corner may be mitred and heat-sealed together as shown in Figure 11. The said corners may be reinforced by flexible corner pieces secured thereover. Alternatively, moulded corner-jointing members of a mouldable heat-sealable material may be used, if desired.

It is advantageous in certain applications to build a protective covering on an existing structure such as, for example, a ship's deck. In this case the jointing member 13 illustrated in Figure 12 may conveniently be used. Figure 13 shows how a covering 14 may be formed on an existing structure 15 using jointing members 13 to connect sheets of material 1 to the structure 15 and jointing members 12 to connect adjacent sheets of material 1.

Other suitable jointing members are shown in section in Figures 14 and 15. Each of these members comprises a web 16 from which two flanges 17 outwardly diverge. Such members could be made to serve three separate functions; i.e. for jointing flat coplanar sheets as shown in Figure 16; for forming corners as shown in Figure 17 or for attaching a container to a structure as shown in Figure 18.

A further jointing member which may be used is that shown at 18 in Figure 19, which has a generally U-shaped cross-sectional form providing a groove 19 into which the edges of two sheets to be joined may be placed side by side.

When the U-section member 18 is employed in joining sheets of the material 1 by radio frequency dielectric heating, an electrode assembly of the form illustrated in Figures 20 and 21 may conveniently be employed, such assembly comprising two pressure members 20 carrying electrodes 21 between which the member 18 may be held. Figure 22 shows a modification in which the straight electrodes 21 are replaced by curved electrodes 22. In one method of use of the assembly of Figures 20 and 22 the potentials of the electrodes may form a balanced system about earth potential. In another the lead foil 2 may be earthed by capacitive coupling and the radio-frequency generator output connected to the electrodes which are electrically strapped together. The illustrated electrode systems act as moulds which ensure that the edging provided by the member 18 has a consistent shape and neat clearly defined edges.

When the two sheets to be joined are in different planes, one of the said sheets is preformed along one edge by bending it through an angle of approximately 90° to a convenient depth, as shown in Figure 21.

This operation brings the edges of the two sheets into parallel relationship and they can then be inserted together into the groove of the U-shaped extruded member. In use of the member 18, fusion or welding is achieved between the sheets themselves and the member 18 as well.

The described joining methods using extruded jointing members provide the means for sealing-off all exposed edges of the material and accordingly eliminate ingress of moisture through capillary action between the laminae.

In order that a protective covering formed from material 1 according to this invention can easily be opened and resealed, such covering preferably incorporates one or more

moisture vapour-tight, water-tight, air-tight and light-tight slide fasteners.

The said fastener or fasteners may be of the form described and claimed in British Patent No. 723,998 or whose manufacture is described in British Patent No. 731,144 or described in British Patent Application No. 20258/56 (Serial No. 868,964).

Alternatively, the fastener or fasteners may be of the form, such as is described in British Patent Specification No. 522,663, which comprises two extruded strips having interfitting parts. The said strips may also have grooves for receiving pieces or parts of material according to this invention so that the latter may be sealed to such extruded strips. Thus the said strips may have grooved parts so formed that, when the fastener is closed the said parts are equivalent to a jointing member of the form previously described.

In one convenient form, the two extruded strips may comprise strips such as the strips 23 and 24 shown in Figure 23, the strip 23 having a longitudinal tongue 25 enlarged at its free end and the strip 24 having a corresponding longitudinal groove 26 to receive the tongue. The two strips 23 and 24 are preferably heat-welded at their ends, which are covered with a metal cap or band holding them tightly together at one end, and a slide 27, as shown in Figure 24, is engaged over the strips, such slide 27 having a tapered hole 28 through which the strips pass. The slide 27 is open at the lower face of the slide and is provided, at its upper part within the hole 28 at the larger end thereof, with a wedge 29 tapering in the same direction as the hole 28 so that, as the slide 27 is moved in one direction, the wedge 29 forces the two strips apart, whilst, as the slide is moved in the opposite direction, the tapering of the hole 28 causes the two strips to be pressed together.

The fastener illustrated in Figure 23 is particularly effective for use in a covering formed of material according to this invention. If the strips 23 and 24 are imagined to be joined so that the tongue 30 fits into the groove 31 and the hook-like part 32 fits into the recess 33, then a pull in the direction of the arrows A will cause the faces 34 and 35 to co-act as a fulcrum and the tongue 30, being fully engaged in groove 31, prevents the tongue 25 from moving upwardly, and the part 32 is thereby locked in the recess 33.

Other useful forms of slide fastener are illustrated in Figures 25 to 30. Instead of being provided with integral co-operating tongue and groove means, these fasteners are provided with interlocking metal parts which, when interlocked, draw the two strips together and cause two portions of the latter to be pressed against one another tightly enough to form a seal. The metal parts may be of any form suitable and may be of any form known in slide fastener manufacture.

In the form illustrated in Figure 25, two extruded strips 36 and 37 each have embedded therein a spiral 38 (see Figure 26) the two spirals being of a form capable of interlocking with one another. In the form illustrated in Figures 27, 28 and 29, one strip 39 includes a flat spiral 40 and the other strip includes a series of arrow-like members or vertebræ 42 adapted to interlock with the spiral 40. In a further alternative each strip may have a series of arrow-like members or vertebræ adapted to interlock with each other.

The metallic components may conveniently be positioned in the extruded strip by heating the metal and pressing it into the strip. Heating may conveniently be applied by induction, conduction or by the passage of an electric current or by using any other convenient method. Accurate register of the metallic component in relation to the extruded strip may conveniently be achieved by the use of jigs.

WHAT WE CLAIM IS:—

1. A flexible, protective, covering, sheet material, comprising a layer of lead foil having adhered to each side thereof a sheet of a fabric impregnated with a flexible, thermoplastic synthetic resin having a thickness of not less than 0.01 inch.

2. A flexible protective covering sheet material according to Claim 1, wherein the said flexible, thermoplastic synthetic resin is a polyvinyl chloride resin.

3. A flexible protective covering sheet material according to Claim 1 or 2, wherein the fabric is woven cotton.

4. A flexible protective covering sheet material according to Claim 1, 2 or 3, wherein the said sheets are adhered to the lead foil by an adhesive having a good preliminary tack.

5. A flexible protective covering sheet material according to Claim 4, wherein the said adhesive is a solution of a mixture of phenol-formaldehyde resin and a synthetic rubber compound.

6. A flexible protective covering sheet material according to any of the preceding claims, wherein the said sheets have a thickness of about 0.014 inch to 0.015 inch.

7. A flexible protective covering sheet material according to any of the preceding claims, wherein the said sheets include pigments rendering them opaque to ultra-violet rays.

8. A method of forming a flexible, protective, covering, sheet material, such method comprising forming two sheets of a fabric impregnated with a flexible, thermoplastic synthetic resin having a thickness of not less than 0.01 inch and adhering the same to lead foil, one of said sheets to each side of the latter, by applying a suitable adhesive be-

tween the said sheets and lead foil and pressing the same together.

9. A method according to Claim 8, wherein the said adhesive is applied to both the lead foil and impregnated fabric sheets.

10. A method according to Claim 8 or 9, wherein the said adhesive is a fire-resistant adhesive having a good preliminary tack.

11. A method according to Claim 10, wherein the said adhesive is a solution of a mixture of phenol-formaldehyde resin and a synthetic rubber compound.

12. A method according to any of Claims 8 to 11, wherein the said flexible, thermoplastic synthetic resin is a polyvinyl chloride resin.

13. A method according to any of Claims 8 to 12, wherein the said fabric is woven cotton.

14. A method according to any of Claims 8 to 13, wherein the said material is formed by coating one side of a sheet of the selected fabric with a paste adapted to form, on the application of heat and pressure, the said thermoplastic synthetic resin, by then applying the said adhesive to the fabric side of the coated fabric sheet and to one side of the lead foil, by hot calendering the assembly of the coated fabric sheet and lead foil and repeating the process to apply a second sheet of coated fabric to the other side of the lead foil.

15. A method according to Claim 14, wherein each said hot calendering operation is followed by a cold calendering operation.

16. A method according to Claim 14 or 15, wherein the said paste comprises polyvinyl chloride and/or a polyvinyl chloride copolymer mixed with a plasticiser and heat and light stabilizers.

17. A protective covering container formed from material according to any of Claims 1 to 7 or from material made according to the method of any of Claims 8 to 16.

18. A flexible protective covering container comprising a plurality of pieces of flexible protective covering sheet material according to any of Claims 1 to 7 or made according to the method of any of Claims 8 to 16, adjacent pieces of said material being joined along adjoining edges by extruded jointing members of extrudable thermoplastic synthetic resin such synthetic resin being heat sealable with the said protective covering sheet material, the said jointing members being provided with grooves into which the sheet edges are received.

19. A flexible protective covering container according to Claim 18, wherein one or more of the said jointing members is a strip of a squat I-shaped cross-sectional form providing two grooves longitudinally of the strip and each of said grooves receives one of two adjoining sheet edges joined by the strip.

20. A flexible protective covering container according to Claim 18 or 19, wherein one or more of the said jointing members is a strip having a U-shaped cross-sectional form providing a single groove longitudinally of the strip and the two adjoining sheet edges which are joined by the strip are located in side-by-side relation in said groove.

21. A flexible protective covering container according to Claim 18, 19 or 20, wherein meeting jointing members are mitred and joined by being heat sealed together.

22. A flexible protective covering container according to any of Claims 18 to 21, wherein the said jointing members are formed of a polyvinyl chloride resin.

23. A flexible, protective, covering container formed of a flexible material comprising a moisture- and moisture vapour-transmission resistant barrier layer of lead foil having adhered to both sides thereof a sheet of a fabric impregnated with a flexible, thermoplastic, synthetic resin and having a thickness of not less than 0.01 inch and including a moisture vapour-tight, water-tight, air-tight and light-tight slide fastener affording access to the interior of the container.

24. A flexible, protective, covering container according to Claim 23 wherein the said slide-fastener comprises two extruded strips having interfitting parts.

25. A flexible, protective, covering container according to Claim 24, wherein the said interfitting parts are integral parts of said strips.

26. A method of forming a flexible, protective, covering container, such method comprising cutting from flexible, protective, covering sheet material according to any of Claims 1 to 7 or made according to the method of any of Claims 8 to 16 a plurality of pieces which, when fitted together, form a container of the desired shape, engaging each pair of adjacent edges of said pieces in a groove in an extruded jointing member comprising an extruded strip of an extrudable thermoplastic synthetic resin heat sealable with the said flexible protective covering sheet material, and joining the said pieces to said strip by the application of heat and pressure.

27. A method according to Claim 26, wherein the said pieces of material are heat sealed to said jointing members by using radio-frequency heating.

28. A method according to Claim 27, wherein each of the said jointing members is of a squat I-shaped cross-sectional form providing two grooves in each of which an edge of one of said pieces is located and the two edges are simultaneously heat sealed to the jointing member by passing a radio-frequency dielectric heating electrode longitudinally along the member, the said electrode having two limbs, one located adjacent to each of the said grooves of the member.

29. A method according to Claim 28,

wherein the said electrode is moved stepwise along the said jointing member.

30. A method according to Claim 27, wherein each of the said jointing members has a U-shaped cross-sectional form providing a single groove in which both of two adjoining edges of said material pieces are engaged and the two edges are heat-sealed to the jointing member by engaging successive parts of the latter between two electrodes and applying pressure and radio-frequency dielectric heating.

31. A method according to Claim 30, wherein two adjacent pieces of material to be joined are in different planes and the edge of one of said pieces is preformed by bending it through an appropriate angle.

32. A flexible protective covering sheet material substantially as herein described with reference to and as shown by the accompanying drawings.

33. A method of forming a flexible protective covering sheet material substantially as herein described with reference to the accompanying drawings.

34. A flexible protective covering container substantially as herein described with reference to and as shown by the accompanying drawings.

35. A method of forming a flexible protective covering container substantially as herein described with reference to the accompanying drawings.

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PROVISIONAL SPECIFICATION
No. 220, A.D. 1957.

A New or Improved Flexible Material, particularly suitable for use as a Protective Covering Material for Packaging and Preservation Purposes

We, B.P.S. (RESEARCH & DEVELOPMENT) LIMITED, a British Company of Staplehurst Road, Sittingbourne, Kent, do hereby declare this invention to be described in the following statement:—

This invention concerns a new or improved flexible material, particularly suitable for use as a protective covering material for packaging and preservation purposes.

Valuable items, such as, for example, machine tools, aircraft components, engines of all kinds, and electrical and electronic apparatus, which have frequently to be transported over great distances or stored for long periods, are often subject to corrosion or other deterioration during transport or storage. Such deterioration is caused mainly by the action of moisture or moisture vapour on the items in question and under very damp climatic conditions the extent of deterioration may be considerable.

It is therefore desirable that such items should be enclosed in a covering which is proof against moisture and moisture vapour and several protective covering materials have been used or proposed for this purpose. Unfortunately, none of these materials has proved to be entirely satisfactory.

It is one object of this invention to provide an improved protective covering material.

According to this invention there is provided a flexible protective covering sheet material comprising lead foil to each side of which is secured, by a suitable adhesive, a layer of polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material.

We have found that lead foil may be adhered to polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and, when secured between two layers of the latter, may be repeatedly folded or crumpled without cracking or puncturing of the foil. Further, since lead is the most corrosion-resistant of metals, the material according to this invention is more corrosion-resistant than known flexible protective covering sheet materials. The incorporation of lead in the material according to this invention may also increase the protection of the item enclosed in the material against radio-active "fall out" following an atomic or thermo-nuclear explosion.

According to a further aspect of this invention, there is provided a method of forming a flexible protective covering sheet material, such method comprising forming two layers of polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and adhering the same to lead foil, one of said layers to each side of the latter, by applying a suitable adhesive between the said layers and lead foil and pressing the same together.

Although the said adhesive may be applied to the lead foil or to both the lead foil and polyvinyl chloride or like layers, preferably the adhesive is applied to the latter alone.

According to a further feature of this invention, the adhesive used to secure the said polyvinyl chloride or like layers to the lead foil may conveniently be an adhesive, preferably a fire-resistant synthetic adhesive, having a good preliminary tack.

Advantageously the said adhesive is a solution the combination of phenolformaldehyde

wherein the said electrode is moved stepwise along the said jointing member.

30. A method according to Claim 27, wherein each of the said jointing members has a U-shaped cross-sectional form providing a single groove in which both of two adjoining edges of said material pieces are engaged and the two edges are heat-sealed to the jointing member by engaging successive parts of the latter between two electrodes and applying pressure and radio-frequency dielectric heating.

31. A method according to Claim 30, wherein two adjacent pieces of material to be joined are in different planes and the edge of one of said pieces is preformed by bending it through an appropriate angle.

32. A flexible protective covering sheet material substantially as herein described with reference to and as shown by the accompanying drawings.

33. A method of forming a flexible protective covering sheet material substantially as herein described with reference to the accompanying drawings.

34. A flexible protective covering container substantially as herein described with reference to and as shown by the accompanying drawings.

35. A method of forming a flexible protective covering container substantially as herein described with reference to the accompanying drawings.

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PROVISIONAL SPECIFICATION
No. 220, A.D. 1957.

A New or Improved Flexible Material, particularly suitable for use as a Protective Covering Material for Packaging and Preservation Purposes

We, B.P.S. (RESEARCH & DEVELOPMENT) LIMITED, a British Company of Staplehurst Road, Sittingbourne, Kent, do hereby declare this invention to be described in the following statement:—

This invention concerns a new or improved flexible material, particularly suitable for use as a protective covering material for packaging and preservation purposes.

Valuable items, such as, for example, machine tools, aircraft components, engines of all kinds, and electrical and electronic apparatus, which have frequently to be transported over great distances or stored for long periods, are often subject to corrosion or other deterioration during transport or storage. Such deterioration is caused mainly by the action of moisture or moisture vapour on the items in question and under very damp climatic conditions the extent of deterioration may be considerable.

It is therefore desirable that such items should be enclosed in a covering which is proof against moisture and moisture vapour and several protective covering materials have been used or proposed for this purpose. Unfortunately, none of these materials has proved to be entirely satisfactory.

It is one object of this invention to provide an improved protective covering material.

According to this invention there is provided a flexible protective covering sheet material comprising lead foil to each side of which is secured, by a suitable adhesive, a layer of polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material.

We have found that lead foil may be adhered to polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and, when secured between two layers of the latter, may be repeatedly folded or crumpled without cracking or puncturing of the foil. Further, since lead is the most corrosion-resistant of metals, the material according to this invention is more corrosion-resistant than known flexible protective covering sheet materials. The incorporation of lead in the material according to this invention may also increase the protection of the item enclosed in the material against radio-active "fall out" following an atomic or thermo-nuclear explosion.

According to a further aspect of this invention, there is provided a method of forming a flexible protective covering sheet material, such method comprising forming two layers of polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and adhering the same to lead foil, one of said layers to each side of the latter, by applying a suitable adhesive between the said layers and lead foil and pressing the same together.

Although the said adhesive may be applied to the lead foil or to both the lead foil and polyvinyl chloride or like layers, preferably the adhesive is applied to the latter alone.

According to a further feature of this invention, the adhesive used to secure the said polyvinyl chloride or like layers to the lead foil may conveniently be an adhesive, preferably a fire-resistant synthetic adhesive, having a good preliminary tack.

Advantageously the said adhesive is a solution the combination of phenolformaldehyde

and that synthetic rubber compound known in the trade as "Hycar" (Registered Trade Mark).

According to a still further feature of this invention, one or both of the said layers of polyvinyl chloride resin or like material may be reinforced by a fabric, either a natural fabric such as cotton, silk or any other fabric formed from vegetable or animal fibres or a synthetic fabric such as rayon, nylon or Terylene (Registered Trade Mark).

Apart from reinforcing the said layers of polyvinyl chloride or like material, the incorporation of a fabric in such layers also has the further advantage that, due to the slightly uneven surface possessed by the fabric, when the said layers and lead foil are pressed together, the lead foil is slightly embossed or corrugated and is thereby rendered more flexible.

Where the said layers are reinforced by a fabric, such layers are preferably each formed by coating, e.g. by a spreading process, one side of the selected fabric with a paste adapted to form, on the application of heat and pressure, the said polyvinyl chloride resin or like corrosion-resistant heat-sealable material and by hot calendering the said coating on to the fabric. Advantageously the said hot calendering operation is followed by a cold calendering operation.

The paste used desirably comprises polyvinyl chloride and/or a polyvinyl chloride copolymer mixed with a plasticiser and heat and light stabilisers.

Conveniently the paste also includes pigments, for example to render the material opaque to ultra-violet rays and, also conveniently, the paste is treated, prior to the hot calendering operation, so as to be non-inflammable and resistant to the spread of flames.

It will be appreciated that, since the said layers adhered to the lead foil are formed of a heat-sealable material, a piece or part of a piece of flexible protective covering sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may be tailored to suit the particular shape of such item and completely to enclose the latter.

Although sealing together of two parts of material according to this invention may be carried out by any method of applying heat, e.g. by induction heating or by hot air, advantageously high frequency dielectric heating is used.

According to a further feature of this invention, where high frequency heating is used for sealing two parts of material together, the said two parts are overlapped where the seal is to be made and are moved, relatively to a live electrode located between the overlapping parts of the sheet, in a direction extending from the forward end of the electrode to the rear end thereof, pressure being applied to the overlapped parts of the material in a region immediately rearwardly of the rear end of the said electrode.

Thus, according to a further aspect of this invention, there is provided apparatus for the high frequency heat sealing of two sheets of flexible protective covering sheet material provided with outer surfaces of heat-sealable material, such apparatus comprising an electrode, means for feeding in a direction extending from the forward end of the said electrode to the rear end thereof the sheets of material in overlapping relation, with the said electrode located between the overlapping parts of the said sheets, and means for applying pressure to the said overlapping parts in the region immediately rearwardly of the rear end of the said electrode, thereby to obtain a narrow track weld close to the edges of the sheets to be bonded.

Advantageously, the electrode is of flat shoe form. However, the electrode could, if desired, vary in shape, depending on the type of seal required, i.e. a broad knife blade electrode could be used to produce a seal right up to the edge of the sheets, and to a depth depending on the distance that the knife blade is inserted between the sheets.

At the very high frequency used for dielectric heating the capacity effect of the large surface area of the lead foil laminate compared with the small area of the live electrode causes the lead foil to behave as a virtual earth and the high frequency heating field is generated between the live electrode and each lead laminate, i.e. polyvinyl chloride or like material is required to be softened for the welding. Once the polyvinyl chloride or like material has been sufficiently softened where desired, it only remains to unite the two layers under slight pressure and allow them to cool, preferably still under pressure. This is conveniently achieved by using suitably shaped follow-up pressure bars or a series of paired follow-up pressure rollers.

This invention also includes a protective covering, e.g. a bag or other container, tailored from material according to this invention.

Where possible, when an edge seal is made in the construction of a container, the latter is preferably turned inside out and the inside of the edge seal reinforced by applying thereto an additional tape of polyvinyl chloride or like material, which may be supported or unsupported as desired, and sealing such tape to the container by high frequency dielectric heating.

It is often desired that some items which have to be protected for long periods against corrosion or other deterioration should be able to be inspected at intervals throughout

such period. Often, with protective covering materials used hitherto, such an inspection has required that the protective covering be destroyed so that it has subsequently to be renewed.

It is a further object of this invention to provide a protective covering which can easily be opened and resealed again. Thus, according to a still further aspect of this invention, there is provided a protective covering formed of a flexible material according to this invention and incorporating one or more watertight, air-tight and light-tight slide fasteners, such as those fasteners described and claimed in British Patent No. 723,998 or British Patent No. 731,144 or described in British Patent Application No. 20258/56 (Serial No. 868,964).

In the specification of the aforementioned patents and patent application the slide fasteners there disclosed are mounted on a fabric reinforced synthetic rubber sheeting. Since such sheeting is not entirely proof against moisture or moisture vapour, according to a further feature of this invention the or each slide fastener is mounted on a piece of flexible protective covering sheet material according to this invention. Such piece of material to which the slide fastener is secured may advantageously be incorporated in a protective covering by heat sealing such piece to the material forming the main part of the said covering.

In order that this invention may more readily be understood, one flexible protective covering sheet material according to this invention and the method of making the same will now be described by way of example.

In this example, the material comprises lead foil having a thickness of about 0.003" to each side of which is adhered, by a synthetic adhesive formed of a solution of the combination of phenol-formaldehyde and the synthetic rubber compound known in the trade as "Hycar" (Registered Trade Mark), a layer of cotton fabric reinforced polyvinyl chloride resin having a thickness of about 0.012".

The method used to form this material is as follows:—

Firstly, each of two sheets of cotton fabric is coated by spreading over one surface thereof a paste formed of polyvinyl chloride resin mixed with plasticisers, heat and light stabilisers and pigments and the said coated fabric sheets are then hot calendered and subsequently cold calendered. Next, the said adhesive is applied to each of the two coated fabric sheets to the surface thereof opposite to that to which the said paste was applied and the lead foil is introduced between the two sheets with the adhesive coated surfaces thereof adjacent the surfaces of the lead foil and finally the assembly of sheets and foil is hot calendered and subsequently cold calendered.

Instead of applying the two sheets to the lead foil at the same time, as above described, one sheet may be applied first and the assembly so formed subjected to calendering operation and the other sheet then applied and further calendering operations performed.

The composition of the said paste used in the manufacture of the hereinbefore described material may be varied to suit the particular purpose to which the material is to be put. Thus, where the cold flow and cold flexibility characteristics of the material are required to be good, a sebacate type of plasticiser may be used, and, where the material has to be exposed for long periods to tropical sunlight, the pigments used may be such as to render the material resistant to ultra violet rays and may thus be selected mainly from the dark colour range, carbon black being a good pigment for this purpose.

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PROVISIONAL SPECIFICATION
No. 10216, A.D. 1957.

A New or Improved Flexible Material, particularly suitable for use as a Protective Covering Material for Packaging and Preservation Purposes

We, E.P.S. (RESEARCH & DEVELOPMENT) LIMITED, a British Company of Staplehurst Road, Sittingbourne, Kent, do hereby declare this invention to be described in the following statement:—

This invention concerns a new or improved flexible material, particularly suitable for use as a protective covering material for packaging and preservation purposes.

Valuable items, such as, for example, machine tools, aircraft components, engines of all kinds, and electrical and electronic apparatus, which have frequently to be transported over great distances or stored for long periods, are often subject to corrosion or other deterioration during transport or storage. Such deterioration is caused mainly by the action of moisture or moisture vapour on the items in

question and under very damp climatic conditions the extent of deterioration may be considerable.

It is therefore desirable that such items should be enclosed in a covering which is proof against moisture and moisture vapour and several protective covering materials have been used or proposed for this purpose. Unfortunately, none of these materials has proved to be entirely satisfactory.

It is one object of this invention to provide an improved protective covering material.

According to this invention there is provided a flexible protective covering sheet material comprising lead foil to each side of which is secured, by a suitable adhesive, a sheet of fabric reinforced polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material, e.g. a copolymer of polyvinyl chloride. By the term "sheet", we mean a layer having a thickness of 0.01 inch or more.

We have found that lead foil may be adhered to fabric reinforced polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and, when secured between two sheets (as hereinbefore defined) of the latter, may be repeatedly folded or crumpled without cracking or puncturing of the foil. Further, since lead is the most corrosion-resistant of common metals, the material according to this invention is more corrosion-resistant that known flexible protective covering sheet materials. The incorporation of lead in the material according to this invention may also increase the protection of the item enclosed in the material against radio-active "fall out" following an atomic or thermo-nuclear explosion.

According to a further aspect of this invention, there is provided a method of forming a flexible protective covering sheet material, such method comprising forming two sheets of fabric reinforced polyvinyl chloride resin or like flexible corrosion-resistant heat-sealable material and adhering the same to lead foil, one of said sheets to each side of the latter, by applying a suitable adhesive between the said sheets and lead foil and pressing the same together.

Although the said adhesive may be applied either to the lead foil or to the fabric reinforced polyvinyl chloride or like sheets alone, preferably the adhesive is applied to both the lead foil and fabric reinforced polyvinyl chloride or like sheets.

According to a further feature of this invention, the adhesive used to secure the said polyvinyl chloride or like sheets to the lead foil may conveniently be an adhesive, preferably a fire-resistant synthetic adhesive, having a good preliminary tack.

Advantageously the said adhesive is a solution of the combination of phenolformaldehyde and that synthetic rubber compound known in the trade as "Hycar" (Registered Trade Mark).

According to a still further feature of this invention, the said fabric used to reinforce the said sheets of polyvinyl chloride resin or like material may be a natural fabric such as cotton, silk or any other fabric formed from vegetable or animale fibres or a synthetic fabric such as rayon, nylon or Terylene (Registered Trade Mark).

Apart from reinforcing the said sheets of polyvinyl chloride or like material, the incorporation of a fabric in such sheets also has the further advantage that, due to the slightly uneven surface possessed by the fabric, when the said sheets and lead foils are pressed together, the lead foil is slightly embossed or corrugated and is thereby rendered more flexible.

Although the material according to this invention could be formed by first forming the said fabric reinforced sheets and then adhering such sheets to the lead foil, preferably the material is formed by coating, e.g. by a spreading process, one side of a sheet of the selected fabric with a paste adapted to form, on the application of heat and pressure, the said polyvinyl chloride resin or like corrosion-resistant heat-soluble material, by then applying adhesive to the fabric side of the coated fabric sheet and to one side of the lead foil, by hot calendering the assembly of coated fabric sheet and lead foil and finally repeating the process to apply a second sheet of coated fabric to the other side of the lead foil. Advantageously each said hot calendering operation is followed by a cold calendering operation.

The paste used desirably comprises polyvinyl chloride and/or a polyvinyl chloride copolymer mixed with a plasticiser and heat and light stabilisers.

Conveniently the paste also includes pigments, for example to render the material opaque to ultra-violet rays and, also conveniently, the paste is treated so as to be non-inflammable and resistant to the spread of flames.

Since the said sheets adhered to the lead foil are formed of a heat-sealable material, a piece or part of a piece of flexible protective covering sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may be tailored to suit the particular shape of such item and completely to enclose the latter.

Although two pieces of material according to this invention or two parts of a single piece of such material may be joined by overlapping the said pieces or parts and heat sealing the same together, with a reinforcement if desired, preferably, according to a

further feature of this invention, one or more jointing members formed of a corrosion-resistant heat-sealable material compatible with the polyvinyl chloride resin or like material used to form the fabric reinforced sheets is or are inserted at the junction of the two pieces or parts to be joined and the latter are heat sealed to the said jointing member or members.

Each said jointing member will desirably be formed of such a thickness as to be substantially proof against moisture vapour without requiring lead foil therein and advantageously comprises an extruded strip of polyvinyl chloride resin or like heat-sealable extrudable material, e.g. a copolymer of polyvinyl chloride, having a groove or grooves therein to receive the material pieces or parts to be joined. Such jointing member could, of course, be used for jointing two parts of any heat-sealable material and is not restricted to use with material according to this invention.

Thus, according to a further aspect of this invention, there is provided a method of joining two pieces of heat-sealable material or two parts of a single piece of such material, such method comprising locating the said pieces or parts in a groove or grooves in a jointing member comprising an extruded strip of a heat-sealable extrudable material such as polyvinyl chloride resin and joining the said material pieces or parts to said strip by the application of heat and pressure.

According to a further feature of this invention, the said jointing member comprises a strip having therein two longitudinal grooves each adapted to receive a different one of the two pieces or parts to be joined.

Where the pieces or parts of material are to be joined so as to be co-planar, or substantially co-planar, the said jointing member desirably comprises a strip having a longitudinal groove in each of its opposite side edges, i.e. a strip having a somewhat squar I-shaped cross-sectional form. Where, however, the pieces or parts of material are to be joined so that their planes are at an angle to one another, the said jointing member desirably comprises a strip having two longitudinal parts or flanges diverging from one another at the desired angle and having longitudinal grooves in their outer edges. A particularly useful jointing member would be one having an L-shaped cross-section and having a longitudinal groove in the free edge of each flange of the member. Such a member would enable two pieces or parts of material to be secured together with their planes at right angles to one another.

Where, in the construction of a protective covering from material according to this invention, two or more of said jointing members meet, they may easily be mitred and heat-sealed together to produce a secure and sealed joint. The corners of such a protective covering may also be formed by jointing members mitred and heat-sealed together. For example, in forming a rectangular parallelepipedonal box-like covering from six panels of materials, each panel forming a side of said covering and being secured to adjacent panels along edges of the covering, the said jointing members of an L-shaped cross-section may be used for joining adjacent panels together and the three mutually perpendicular jointing members meeting at each corner may be mitred and heat-sealed together. The said corners may be reinforced by flexible corner pieces secured thereover. Alternatively, moulded corner jointing members of a mouldable heat-sealable material may be used, if desired.

In the formation of a completely closed covering, since access to the interior of the covering cannot be afforded when joining the last open edges of material, the latter may conveniently be joined by a jointing member comprising a strip having a single longitudinal groove in one edge thereof, e.g. a jointing member having a U-shaped cross-section, the said two edges being introduced side-by-side into said groove and the sides of the member on either side of said groove then pressed together whilst heat is applied to seal the assembly together. Such a single grooved member could also be used to provide a smooth sealed edge to a covering e.g. an apron, which is not to be totally closed.

Although sealing of two pieces ro parts of material according to this invention together or to a jointing member may be carried out out by any method of applying heat, e.g. by induction heating or by hot air, advantageously high frequency dielectric heating is used.

Although sealing of two pieces or parts of vention, where high frequency heating is used for sealing two pieces of parts of material together, the said two pieces or parts are overlapped where the seal is to be made and are moved, relatively to a live electrode located between the overlapping parts of the material, in a direction extending from the forward end of the electrode to the rear end thereof, pressure being applied to the overlapped parts of the material in a region immediately rearwardly of the rear end of the said electrode.

Thus, according to a further aspect of this invention, there is provided apparatus for the high frequency heat sealing of two sheets of flexible protective covering sheet material provided with outer surfaces of heat-sealable material, such apparatus comprising an electrode, means for feeding in a direction extending from the forward end of the said electrode to the rear end thereof the sheets of material in overlapping relation, with the said electrode located between the overlapping parts of the said sheets, and means for applying pressure to the said overlapping parts in

the region immediately rearwardly of the rear end of the said electrode, thereby to obtain a narrow track weld close to the edges of the sheets to be bonded.

Advantageously, the electrode is of flat shoe form. However, the electrode could, if desired, vary in shape, depending on the type of seal required, i.e. a broad knife blade electrode could be used to produce a seal right up to the edge of the sheets, and to a depth depending on the distance that the knife blade is inserted between the sheets.

At the very high frequency used for dielectric heating the capacity effect of the large surface area of the lead foil laminate compared with the small area of the live electrode causes the lead foil to behave as a virtual earth and the high frequency heating field is generated between the live electrode and each lead laminate, i.e. only where the polyvinyl chloride or like material is required to be softened for the welding. Once the polyvinyl chloride or like material has been sufficiently softened where desired, it only remains to unite the two layers under slight pressure and allow them to cool, preferably still under pressure. This is conveniently achieved by using suitably shaped follow-up pressure bars or a series of paired follow-up pressure rollers.

According to a further feature of this invention, where an extruded jointing member having two grooves therein is used to form a joint between two pieces or parts of material, the said member is laid on a suitably shaped supporting surface and a high frequency sealing tool guided along the member so as to press the same towards said supporting surface. Preferably the said tool will comprise a radio frequency dielectric heating head having two parallel electrodes spaced apart by a distance such that one electrode registers with each of said grooves when the tool is placed in position on the member and a pair of pressure bars located behind the said electrodes so as to apply pressure to the part of the member last heated as the tool is moved therealong.

Conveniently the tool is provided with a guard or safety shield for the electrodes and advantageously the said guard or shield may engage the edges of the extruded strip member and act to guide the tool along the latter. The said guard or shield is conveniently transparent and may be advantageously formed of methylmethacrylate resin. Preferably the said guard or shield is sprung loaded so that the tool can run over a joint between two jointing members without having to be lifted off from the member on one side of said joint and replaced on the member on the other side of said joint.

According to a further feature of this invention, the tool may include a microswitch in the heater circuit and normally biased in a direction opening the said circuit, but positioned to close said circuit only when the electrodes of the tool are in contact with a jointing member.

In one form, the tool may be adapted to be manually operated and include a handle whereby an operator can traverse the tool along and apply pressure to a jointing member. In another form the tool may be motor operated and include a fractional horse-power motor geared down to a suitable low speed, e.g. 2 revolutions per minute, and driving wheels, for example having a diameter of 2½ inches, by which the tool may be caused to traverse along the jointing member. The weight of the motor would probably provide the pressure required on the pressure bars, although additional weight could be provided if desired.

According to a further feature of this invention, where the tool is motor operated, the radio frequency generator for the heater electrodes may be suspended from an overhead track or rail along which the generator may be traversed as necessary.

If desired, the tool may comprise two pairs of electrodes, one pair for each of the said grooves in the jointing member.

As in the already mentioned case of the sealing of two pieces or parts of material according to this invention together in overlapping relation, when using a tool as above described for sealing such material to a jointing member, the lead foil acts as a virtual earth and the high frequency field is generated between the live electrodes and the foil of each piece or part of material. Since the live electrodes are always applied to an outer surface, they can be completely shrouded, e.g. by using the said guard or shield.

If desired, prior to sealing the material to a jointing member, such material may be connected thereto or "tacked" in a selected few places by spot welding.

This invention also includes a protective covering, e.g. a bag or other container, tailored from material according to this invention.

It is often desired that some items which have to be protected for long periods against corrosion or other deterioration should be able to be inspected at intervals throughout such period. Often, with protective covering materials used hitherto, such an inspection has required that the protective covering be destroyed so that it has subsequently to be renewed.

It is a further object of this invention to provide a protective covering which can easily be opened and resealed again. Thus, according to a still further aspect of this invention, there is provided a protective covering formed of a flexible material according to this invention and incorporating one or more water-tight, air-tight and light-tight slide fasteners.

The said fastener or fasteners may be of the form described and claimed in British Patent No. 723,998 or British Patent No. 731,144 or described in British Patent Application No. 20258/56 (Serial No. 868,964).

In the specifications of the aforementioned patents and patent application the slide fasteners there disclosed are mounted on a fabric reinforced synthetic rubber sheeting. Since such sheeting is not entirely proof against moisture or moisture vapour, according to a further feature of this invention the or each slide fastener is mounted on a piece of flexible protective covering sheet material according to this invention. Such piece of material to which the slide fastener is secured may advantageously be incorporated in a protective covering by heat sealing such piece to the material forming the main part of the said covering, using a jointing member if desired.

Alternatively, the fastener or fasteners may be of the form, such as is described in British Patent Specification No. 522,663, which comprises two extruded strips having interfitting parts.

According to a further feature of this invention each said slide fastener used in a protective covering according to this invention may be formed of two extruded strips of a heat-sealable extrudable material having interfitting parts and also having grooves for receiving pieces or parts of material according to this invention so that the latter may be sealed to such extruded strips. Thus the said strips may have grooved parts so formed that, when the fastener is closed the said parts are equivalent to a jointing member of the form previously described.

In one convenient form, the two extruded strips forming the fastener have integral co-operating tongue and groove means, one strip having a longitudinal tongue enlarged at its free end and the other strip having a corresponding longitudinal groove to receive the said tongue, the two strips having a sheet metal end cap or band holding them tightly together at one end and a slide engaged over the strips and having a tapered hole through which the strips pass and open at the lower face of the slide, the slide being provided at its upper part within the said hole at the larger end thereof with a wedge tapering in the same direction as the said hole so that, as the slide is moved in one direction the said wedge forces the two strips apart, whilst as the slide is moved in the opposite direction the tapering of the said hole causes the two strips to be pressed together.

In other forms, the said two strips forming the fastener may, instead of being provided with integral co-operating tongue and groove means, be provided with interlocking metal parts which, when interlocked draw the two strips together and cause two portions of the latter to be pressed against one another tightly enough to form a seal. The said metal parts may be of any form suitable and may be of any form known in slide fastener manufacture. Thus both extruded strips may have embedded therein, or sprung into a suitably shaped recess therein, a spiral, the two spirals being of a form capable of interlocking with one another. Alternatively, one strip may include a flat spiral and the other a series of arrow-like members or vertibræ adapted to interlock with the said spiral. In a further alternative each strip may have a series of arrow-like members or vertebræ adapted to interlock with each other.

In order that this invention may more readily be understood, one flexible protective covering sheet material according to this invention and the method of making the same wil now be described by way of example.

In this example, the material comprises lead foil having a thickness of about 0.003" to each side of which is adhered, by a synthetic adhesive formed of a solution of the combination of phenol-formaldehyde and the synthetic rubber compound known in the trade as "Hycar" (Registered Trade Mark), a layer of cotton fabric reinforced polyvinyl chloride resin having a thickness of about 0.014 or 0.015".

The method used to form this material is as follows:—

Firstly, a sheet of cotton fabric is coated by spreading over one surface thereof a paste formed of polyvinyl chloride resin mixed with plasticisers, heat and light stabilisers and pigments and the said adhesive is then applied to the fabric side of the said coated fabric sheet and to one side of the lead foil. The assembly of coated fabric sheet and lead foil are then hot calendered and subsequently cold calendered. The process is then repeated to apply a second sheet of coated fabric to the other side of the lead foil.

The hot calendering is carried out at a minimum temperature of 250° F. and the calender rolls and rolls feeding the foil and coated fabric sheets and taking up the assembly formed are synchronised to a single speed so that no relative stretching occurs of the layers forming the assembly.

Instead of applying the two sheets to the lead foil one after the other, as above described, both sheets may be applied at the same time, if desired.

The composition of the said plate used in the manufacture of the hereinbefore described material may be varied to suit the particular purpose to which the material is to be put. Thus, where the cold flow and cold flexibility characteristics of the material are required to be good, a sebacate type of plasticiser may be used, and, where the material has to be exposed for long periods to tropical sunlight, the pigments used may be such as to render

the material resistant to ultra violet rays and may thus be selected mainly from the dark colour range, carbon black being a good pigment for this purpose.

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887,956
5 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

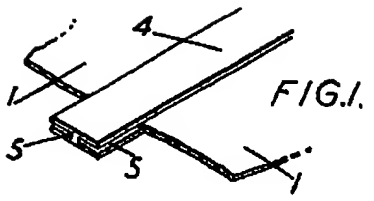


FIG.1.

FIG.2.

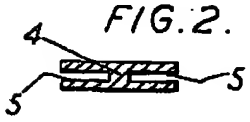


FIG.3.

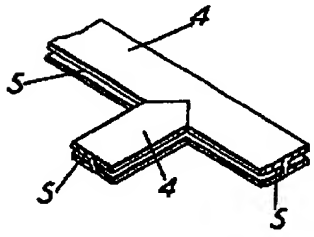


FIG.4.

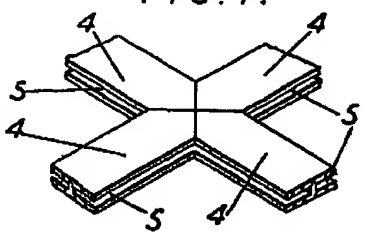


FIG.5.

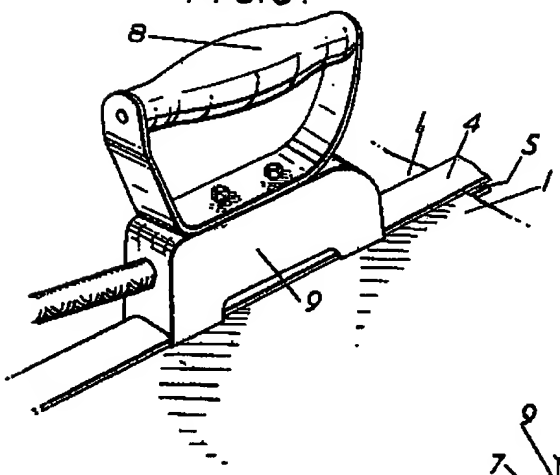


FIG.6.

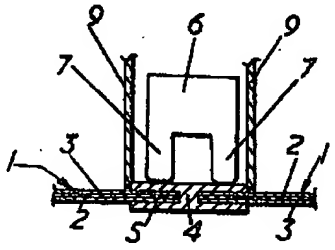
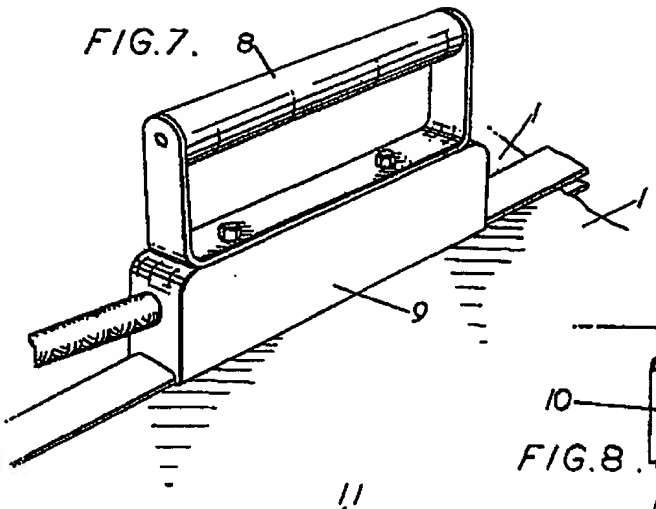


FIG.7.



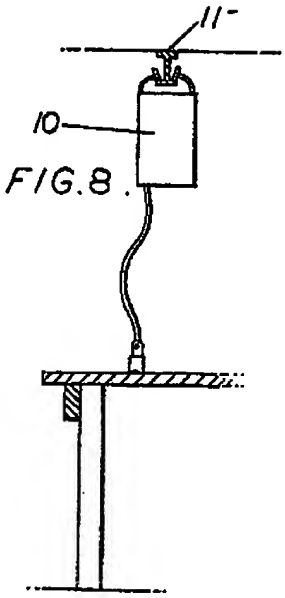


FIG.8.

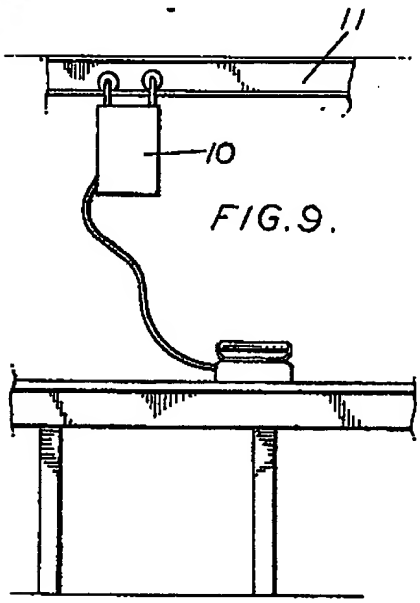


FIG.9.

FIG.11

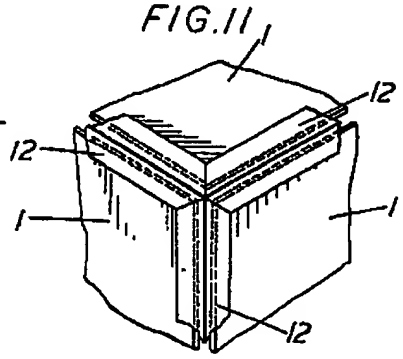
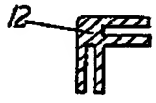


FIG.10.



887,956 COMPLETE SPECIFICATION
5 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 2 & 3

FIG.12.

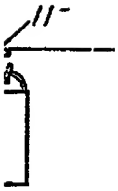


FIG.13.

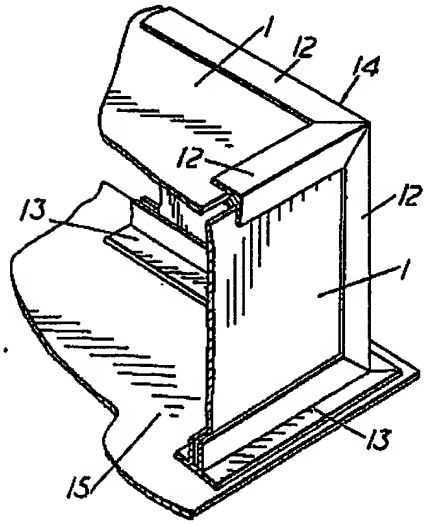


FIG.14.

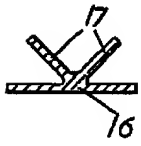


FIG.15.

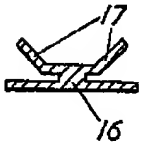
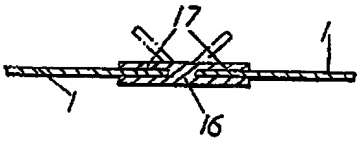


FIG.16.



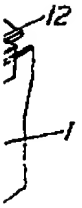


FIG.17.

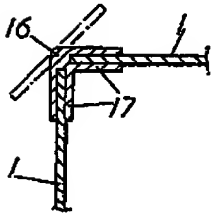
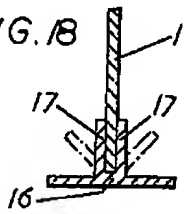


FIG.18



887,956 COMPLETE SPECIFICATION

5 SHEETS

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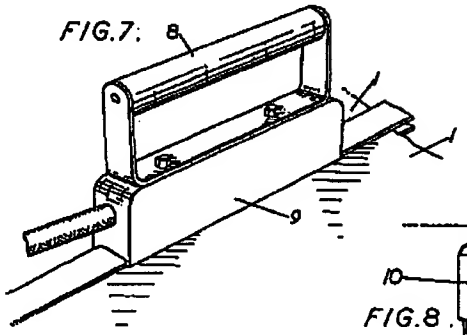
SHEETS 2 & 3

FIG.7.



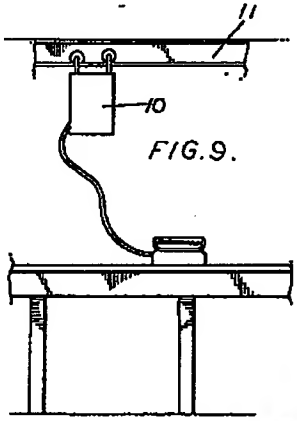


FIG.9.

FIG.8.

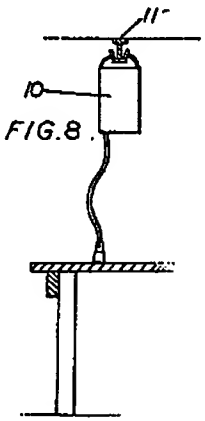


FIG.10.

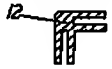


FIG.11.

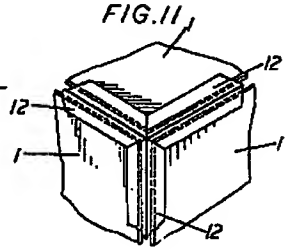


FIG.12.

FIG.13.

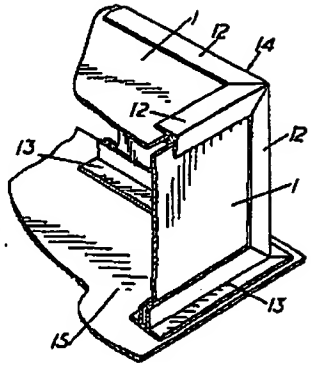


FIG.14.

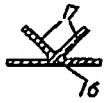


FIG.15.

FIG.16.

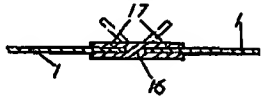


FIG.17.

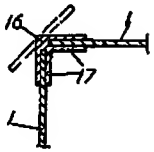
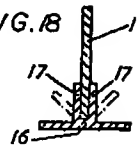


FIG.18.



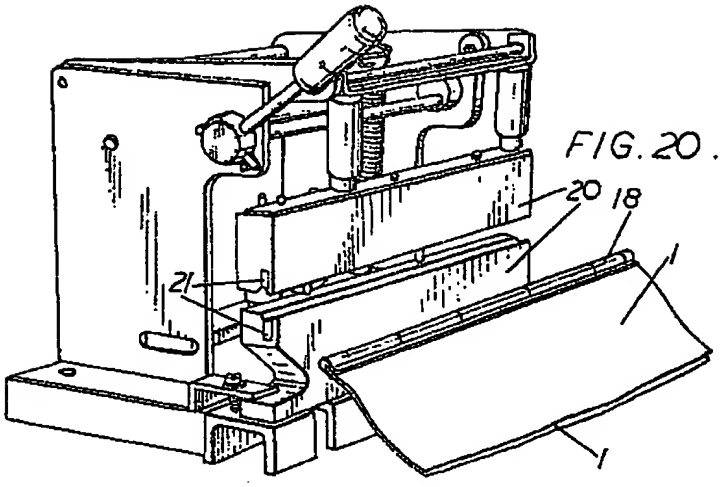


FIG. 20.

FIG. 19.

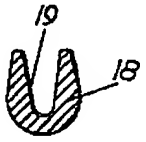


FIG. 21.

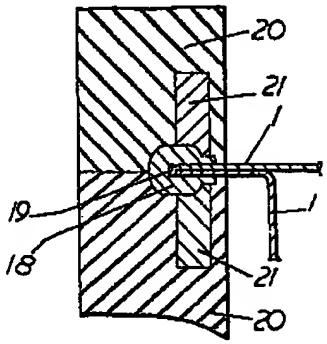
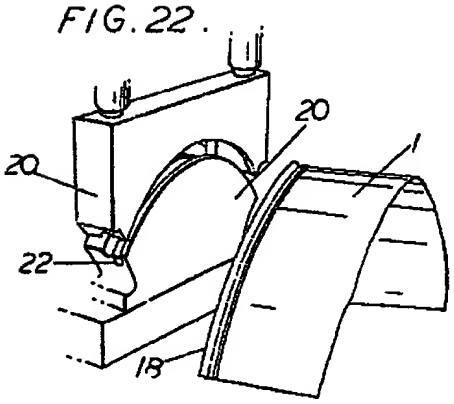


FIG. 22.



887,956 COMPLETE SPECIFICATION
5 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 4 & 5

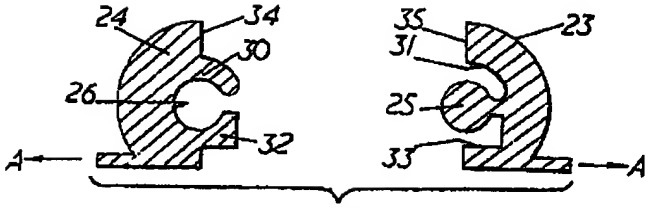


FIG. 23.

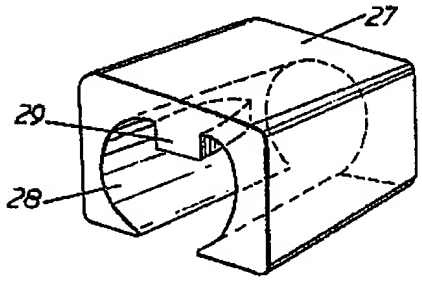


FIG. 24.

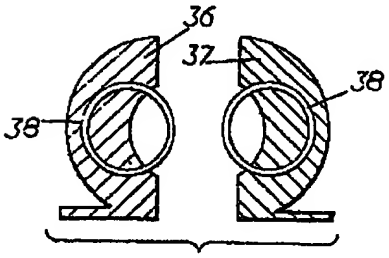


FIG. 25.

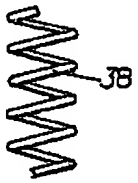


FIG. 26

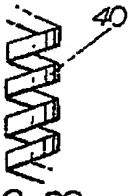


FIG. 28.

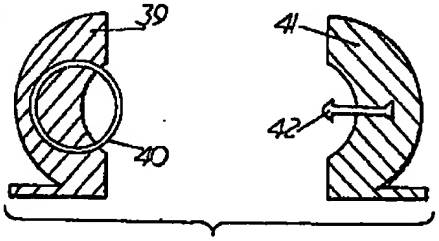


FIG. 27.

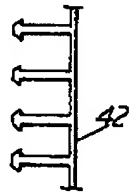


FIG. 29.

887,956 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 4 & 5

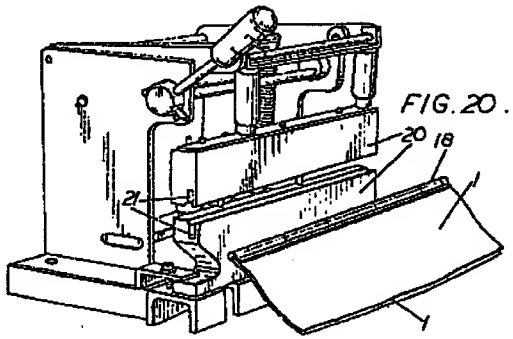


FIG. 20.

FIG. 19.

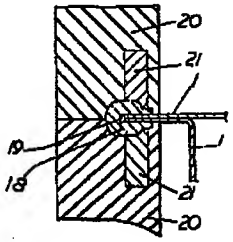


FIG. 21.

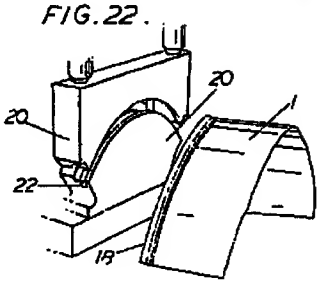


FIG. 22.

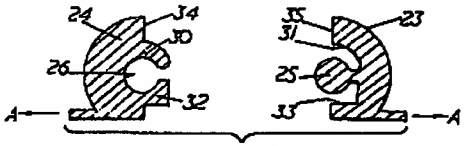
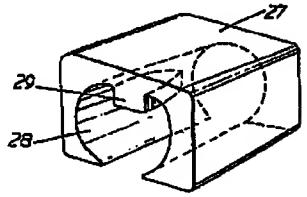


FIG. 23.



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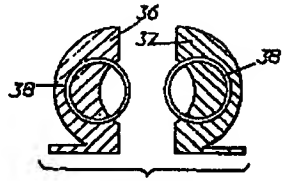

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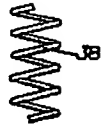

FIG. 26

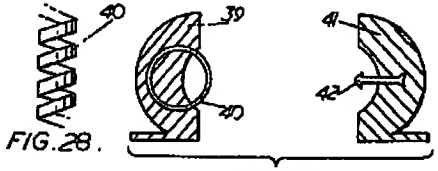

FIG. 28.

FIG. 27.

FIG. 29.